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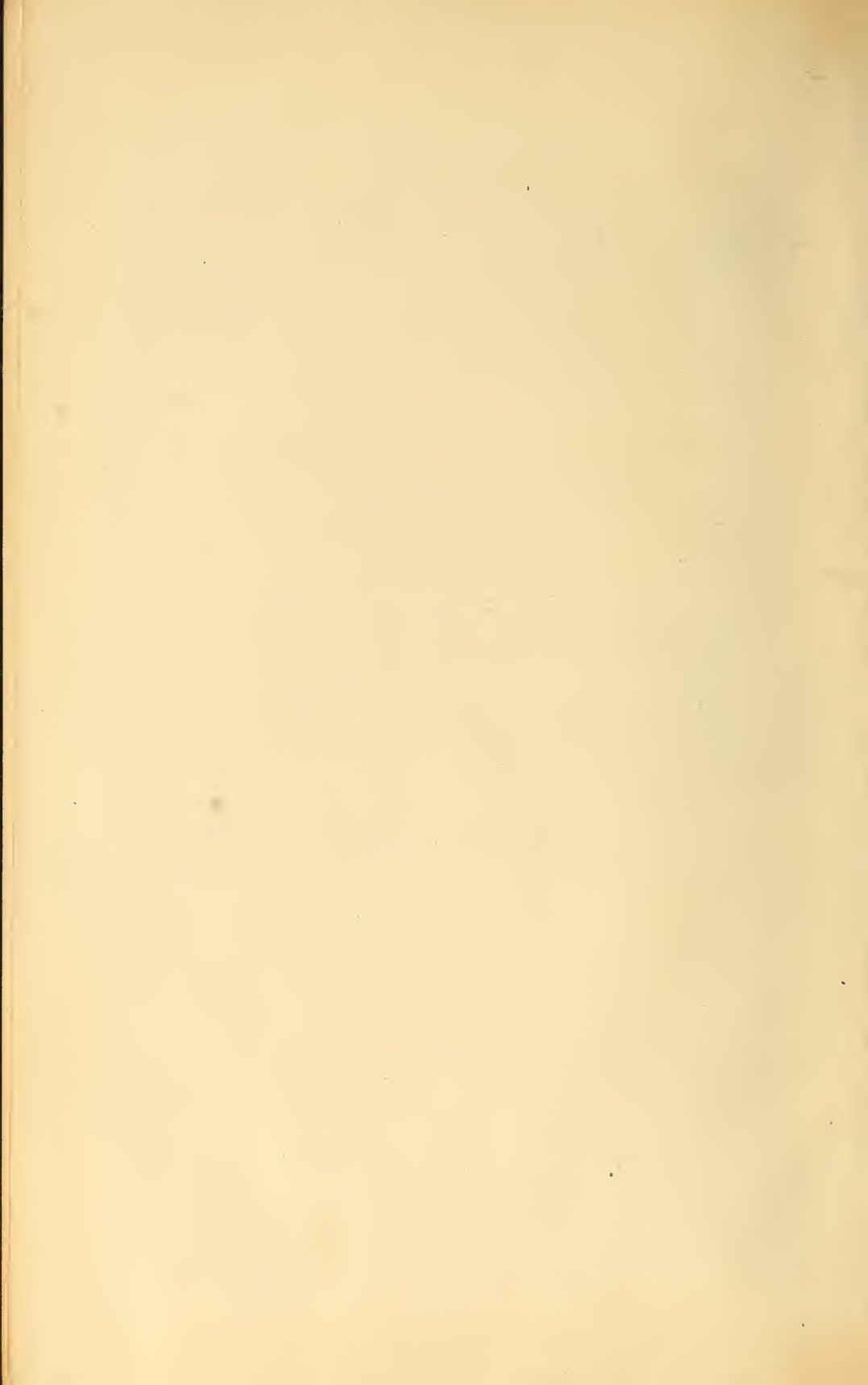
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Cincinnati University Observatory

INAUGURAL REPORT

OF THE

DIRECTOR

OF

The Cincinnati Observatory,

7
30th June, 1868.

ANNUAL REPORT

OF THE

DIRECTOR OF THE CINCINNATI OBSERVATORY,

1st MAY, 1869.

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CINCINNATI:

Robert Clarke & Co., Printers.

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PREFATORY.

IN 1859, Professor O. M. Mitchel, who had been the Astronomical Director of the Cincinnati Observatory from its foundation, removed to Albany, and left the Observatory to the charge of his assistant, Mr. H. Twitchell, who resigned the responsibility in 1861, and was succeeded by Mr. W. M. Davis, who resided in the building until November, 1868.

At the annual meeting of the stockholders of the Astronomical Society, held April 8, 1859, John P. Foote was elected President; William Hooper, Secretary; William Goodman, Treasurer; and O. M. Mitchel, Charles Stetson, Pollock Wilson, Griffin Taylor, S. C. Parkhurst, A. M. Taylor, Wm. Greene, and George Carlisle, Directors.

These gentlemen held their offices until the 27th of June, 1867, when another election resulted in the choice of Alphonso Taft, President; William Hooper, Secretary; William Goodman, Treasurer; and Joseph Torrence, John Carlisle, Edmund Dexter, George Graham, L. B. Harrison, T. D. Lincoln, Rufus King, and S. Davis, Jr., Directors. The vacancy caused by the resignation of Joseph Torrence was shortly afterward filled by the election of Robert Buchanan.

The first act of the new Board of Control was to secure temporary subscriptions to make the much-needed repairs of the building, and to conduct the Observatory, until some plan for the endowment and proper support of the institution could be matured. A subscription of \$100 a year for three years was soon obtained from each of the following gentlemen:

<i>John Shillito,</i>	<i>Hoover, Pumphrey & Co.,</i>
<i>L. B. Harrison,</i>	<i>Rufus King,</i>
<i>Julius Dexter,</i>	<i>Samuel Davis, Jr.,</i>
<i>Wm. Hooper,</i>	<i>Henry Probasco,</i>
<i>Edward Sargent,</i>	<i>G. K. Shoenberger,</i>
<i>R. R. Springer,</i>	<i>John Kilgour,</i>
<i>Peter Neff,</i>	<i>Lewis E. Mills,</i>
<i>Lowell Fletcher,</i>	<i>T. D. Lincoln,</i>
<i>Robert Mitchell,</i>	<i>Alphonso Taft.</i>

In the winter of 1867-'68, Cleveland Abbe, of the Washington Observatory, was invited to take charge of the Cincinnati Observatory. Mr. Abbe accepted the invitation, and after a preliminary visit in April, 1868, removed to Cincinnati in June of the same year.

The accompanying reports submitted to the Board of Control of the Astronomical Society show the history of the institution since Mr. Abbe has had the charge of it.

The present officers of the Society, as elected at the annual meeting, May 4, 1869, are as follows :

ROBERT BUCHANAN, *President.*
 WILLIAM HOOPER, *Secretary.*
 WILLIAM GOODMAN, *Treasurer.*

Directors.

ALPHONSO TAFT.
 MILES GREENWOOD.
 SAMUEL DAVIS, JR.
 EDMUND DEXTER.
 L. B. HARRISON.
 RUFUS KING.
 T. D. LINCOLN.
 JOHN SHILLITO.

INAUGURAL

Report of the Director

— OF THE —

Cincinnati Observatory

— TO THE —

BOARD OF CONTROL,

June 30, 1868.

GENTLEMEN :

In presenting to you a report on the condition of the Observatory, and on the course that I have pursued during my connection with it, dating from the 1st of the present month, I beg leave to offer the following prefatory remarks, directing your attention to the past history of this institution :

HISTORICAL.

Inspired by the eloquence of Professor O. M. Mitchel, the Astronomical Society was organized as such in May, 1842, and its Astronomer authorized to proceed to Europe and order an equatorial telescope, such as then far surpassed all others on this continent. After his return, in June, 1843, his whole energies were devoted to the erection of a suitable building, and the ceremony of the laying of the corner-stone, on the 10th of Novem-

ber following, must always form an epoch in the history of Cincinnati. The building was so far finished in March, 1845, that the great equatorial, which had arrived in February, could be unpacked and placed in its position. Its performance gave complete satisfaction, and the three thousand visitors during the first year found an abundant gratification of their curiosity, as well as instruction and food for contemplative thought.

As the Society had, however, expressly stipulated that they were not to provide a support for the Director of the Observatory, but left it to him to earn a livelihood by lecturing, teaching and writing, it soon became evident that these latter occupations, as well as the interruptions of visitors, were becoming a very severe tax upon his time and strength, almost wholly preventing him from devoting himself to that which the preamble to our constitution well states to be the "duty of every people," *i. e.* "to add, as far as possible, to the general stock of human knowledge."

The second of the four duties imposed on "the Astronomer," in the eighth article of the original constitution, requires that "he shall conduct a series of scientific observations, such as may, in conjunction with other similar observations, conduce to new discoveries, and perfect those already made in the heavens." In order not to obstruct the performance of this important work, it was, in 1846, October 12, ordered by the Board of Directors that the Observatory should be open to visitors only on Thursday, Friday and Saturday of each week; and, in order to complete the apparatus essential to the proper use of the equatorial, means were taken to secure an astronomical clock and a transit instrument. The former was purchased by the late Mr. Wilson McGrew, and it is understood that it was donated to the Observatory without conditions, at least no record of such has come to my knowledge. A transit, made by Troughton in 1816, was

loaned to the Observatory by the United States Coast Survey, which important department of Government service seems to have intended to make this Observatory a central station in its longitude operations. That we do not now continue to occupy this relation to the Coast Survey is a matter of much solicitude, and it is to be hoped that we shall be able to regain our former position.

A room having been built for the transit and its clock, in 1847, they were duly put in place. A chronometer was loaned to the Observatory by the Messrs. E. & G. W. Blunt, of New York city, and the telegraph companies kindly made a connection between their station and the Observatory in 1848, at the request of Prof. Bache. In the autumn of this year, Messrs. Walker and Pourtales determined the difference of longitude between Philadelphia and Cincinnati—a full report of which is published in the proceedings of the American Association for the Advancement of Science, at the meeting held in this city in 1851.

In the previous year the Director had secured the valuable services of Mr. Henry Twitchell as his assistant, and who for twelve years held that position, and was left in charge of the Observatory when Prof. Mitchel removed to Albany in 1859.

It is not necessary for me to detail the straits to which the Director was reduced in order to provide for his own support. He had volunteered to carry on the institution, “if need be, for ten years,” confident that many would be found to sustain him in the position. When, finally, the Monthly Journal, the popular lectures and published writings proved insufficient, he, in 1853-'54, entered upon a work promising still greater pecuniary reward.

Meanwhile, the world-wide interest excited by the building of our Observatory had stirred many cities to emulate Cincinnati in cultivating that science which is properly recognized as “the foster parent of all others.” Among these, Albany, by

the erection of the Dudley Observatory, takes a high rank, and Prof. Mitchel was induced to take the Directorship of that observatory, doubtless in consideration of the comparatively munificent support promised him, as well as far superior instrumental facilities offered for the prosecution of purely scientific investigations.

Those, however, were troublous times, and none could be insensible to the claims of our country upon the loyal citizen. In the midst of a brilliant and successful campaign he was taken from us, who, by his own energy and perseverance, had brought such lasting glory to this city and to his own name. The country lost a patriot, science a benefactor, the world an orator.

The Observatory, now without a head, since Mr. Twitchell had entered into business in this city, and the building already suffering much for want of repairs, and from the neglectfulness of the family who had been allowed to occupy a portion of it, it very fortunately happened that one of our own citizens, Prof. W. M. Davis, offered to occupy the building, and keep it, as well as the grounds, in repair, receiving therefor the free rental and use of the premises, and having the privilege of making such observations with the instrument as his inclinations might dictate. This pleasant arrangement, which still continues in force, has doubtless been of the greatest advantage to the institution, since, otherwise, the buildings and instruments and books must have suffered irreparable damage. For two years Mr. Davis continued to observe a series of moon culminations, such as had been begun here in 1856, in the interest of the Coast Survey, and for which a certain sum was paid annually. This sum was, in whole or in part, spent on the buildings and grounds; but, on the death of Prof. Bache, this stipend was withdrawn, and the transit instrument, which belongs to the Coast Survey, was shortly afterwards removed from the Observatory.

This transit has been replaced by one made by Mr. Davis himself, and which, though his own private property, has been used by him for the purpose of determining the error of the Observatory clock, and is still very kindly placed at our disposal. Attached to the clock is an apparatus for breaking an electric current at every other beat of the pendulum. By this means a record may be made upon what is known as the chronograph. Of this latter valuable instrument, the Observatory possesses no specimen; but one, which is the property of Mr. Davis, and which was made by Messrs. Jas. Foster, Jr. & Co., after designs by Mr. Twitchell, is standing in the transit room by the side of the transit instrument.

As I can not find anything of the chronometer above mentioned as having been loaned to the Observatory, I infer that it has been returned to its owners, probably in 1859, when Prof. Mitchel removed from this city.

In concluding this sketch of our past history, allow me to add that when, on the 1st of February, I accepted the position of Director of the Observatory, it was not then convenient for me to remove hither from Washington, but in April I improved my earliest opportunity to visit this city, and, since the 1st of June, having resigned my position in the National Observatory, my whole time has been devoted to the interests of the Cincinnati Observatory.

INTEREST OF OTHER OBSERVATORIES.

It may be proper here to mention that, both on the occasion of my visit in April, and again on my trip hither in June, I improved every opportunity of visiting the other observatories and astronomers of our country, and it will be interesting to you to know that every where there was exhibited the heartiest pleasure

at learning of the intended resuscitation of our Observatory. Each seemed to seek to find some way in which to offer assistance and encouragement, while all united in deploring the inaction of the past ten years. There is, in astronomy, a continual endeavor on the part of each one to add something to our knowledge by his own original observations and researches; nor does any one feel that he has attained to any degree of usefulness until this has been accomplished; accordingly, all unite in expressing the hope that we shall now push on in the field of astronomical activity, and by laborious observations and computations seek to derive from our fine equatorial whatever of benefit it is calculated to give.

Encouraged by so many friends, and by the hopes so frequently expressed in the early records of the Society, and by the opinions uttered by yourselves verbally, I beg respectfully to commend to you that sentiment that should actuate us, as I apprehend, in our future course:

The pursuit of abstruse astronomical investigations, and the utilization of practical astronomy are equally important to the true interests of the Observatory, and should be simultaneously cultivated.

INVENTORY.

Before considering our future, allow me to detail to you the condition of the Observatory property on the 1st of June. The Society possesses the use of four acres of ground upon Mount Adams, etc.;

The Observatory and dwelling of the Director, etc.;

The furniture contained therein, excepting that belonging to Mr. Davis;

The 11½-inch, 17½-foot equatorial, etc., by Merz and Mähler;

The sidereal clock, by Molyneux, No. 151;

A standard mercurial barometer, by James Green ;

A standard psychrometer, by James Green ;

A thermometer, by James Foster, Jr. & Co. ;

A library of 234 separate volumes or titles ;

The archives, consisting of twenty-four volumes of astronomical observations, and two chests of the former publications of the Society.

BUILDING AND INSTRUMENTS.

It can not be said that the Observatory building is in good repair ; nor would it be possible to make it a comfortable winter residence without considerable expense. The arrangement by which the whole roof is rolled off to the northward or southward, when the equatorial is used, gives much trouble. The entire uncovering of the observing room has also many disadvantages, and, especially, puts the instrument at the mercy of the least breeze that may spring up. Accurate observations can only be taken when there is no wind and no dew.

The equatorial itself is in as good condition as could have been expected. Its better preservation would be insured if it were revarnished and lacquered. The object glass, though it is of Fraunhofer's make, is scarcely equal in definition to those recently manufactured by Alvan Clark, of Cambridgeport, for the observatories of Quebec, Chicago, etc.

THE LIBRARY.

The fragmentary condition of the library demands that all possible means be taken to render it as complete and serviceable as possible ; for, without proper books, it is generally a waste of time to attempt any independent astronomical work, so liable is one to do over what has been done before and better.

Accordingly, I, in April, sought an interview with Prof. Hough, the Director of the Dudley Observatory, and learned

from him that most of the works that had formerly been here had been presented to Prof. Mitchel, as the Director, and had been, at his order, sent to Albany in 1860. A part of these is still there, but the greater part is in the possession of Professor Mitchel's heirs. I have accordingly sought an interview with the members of this family, and am assured that they still retain a deep interest in the welfare of this Observatory, and will present to us all of Prof. Mitchel's library so soon as they have assurance that the books will be properly used and cared for. I expect that this priceless accession to our library will be received within a few weeks.

Doubtless Prof. Hough will also consent to return to us such works from the Observatory's, or from Prof. Mitchel's, library as are still at Albany.

On mentioning our need of astronomical literature to Commodore Benj. F. Sands, the honored Superintendent of the United States Naval Observatory at Washington, he kindly assured me that should there be any duplicate or triplicate volumes in their own library, such as they could readily spare, he would be happy to loan them to us, subject, however, to recall at any time. The volumes thus loaned to us form a most welcome addition to our library, for which we must hope to make due return by our contributions to knowledge.

My own private library, which will be contained in the same room with the Observatory library, completes the list of books at our command.

We are happy to hope that an arrangement may be made with the public libraries of the city by which we may have access to any work they may possess, and which is not contained in our own collection.

As it behooves us diligently to watch for opportunities to improve our library, I take pleasure in calling attention to the

fact that the scientific library of the late Prof. Bache is now rapidly being sold or given away. There are, however, still remaining some works that we should desire to possess. Similarly I learn that the library of the late Dr. John Locke contained many works of special interest and value to us, which we would do well to secure if possible.

Among the donations to our library, we have further to record the gift by Mr. H. P. Tuttle, through Prof. A. Hall, of a large package of numbers of the *Astronomische Nachrichten*.

EXCHANGES AND ACKNOWLEDGMENTS.

It is well understood by the Board of Control that, in order to secure a speedy dissemination of the results obtained by any *savant*, it is the long-established custom for such person, or the society who publishes his works, to distribute them gratuitously to such as are engaged in similar labors. It is, however, always expected that a proper acknowledgment of the reception of such work will be sent to the author, and that the recipient will return the favor, in due course of time, by the gift of copies of his own publications. In this way it is chiefly that we must hope to increase our own library. But I find that, by long neglect to return proper acknowledgment, and by failing to present our own publications, we have much diminished the circle of our exchanges. There are now on hand gifts from about fifty societies, or individuals, that ought to be duly acknowledged, and the acknowledgment accompanied by the presentation of such of the Society's publications as now remain on hand. The writing of these letters, and the transmission of these publications, through the Smithsonian Institution engage my earnest attention, now that I have finished the catalogue of the books that belonged to the Observatory on the 1st of June.

ARCHIVES.

The record of the observations made here since 1845, are, as before stated, contained in twenty-four volumes of observations and some twenty volumes of miscellaneous computations. Two additional volumes are in the hands of Prof. Twitchell; these will be returned to the care of the Observatory. I have devoted one day to making myself acquainted with the contents of these volumes, and do not hesitate to say that there is contained therein the material for at least one volume of valuable astronomical results, which ought to be published during the coming year, if Messrs. Twitchell and Hough consent thereto, so far as their own observations are concerned. The family of Prof. Mitchel have expressed their willingness to intrust the entire publication to my discretion, so far as concerns the labors of their lamented father.

It has been in vain that I have attempted to obtain a complete set of the publications of the Society, of the Observatory and of Prof. Mitchel. I deem it of great interest and importance that such a complete set should be preserved in the Archives of the Observatory, and I trust that members of the Board or of the Society having any such works, and willing to part with them, will remember the needs of our library.

OBSERVATIONS.

Although severely tasked by the many calls upon my time and strength, I have been able to improve much of the pleasant weather of the past three weeks, and, although my labors have mostly resulted in showing the difficulties against which one will have to contend in the atmosphere, the want of a dome, the imperfections of the driving clock, and the inconvenience of the

observing bench ; yet it is as well for me to mention that on the 20th I first obtained such observations as enabled me to determine with approximate accuracy the errors in the position of the equatorial. It was impossible for me to observe such stars as were needed in order to get a better result on account of the interference of the movable roof, but I concluded that the results would justify me in proceeding to examine the southern heavens for new double stars, and in determining their approximate positions, to which work I have since then mostly confined my attention. The work will be continued, although the results, owing to the unfavorable atmosphere surrounding us, can not be otherwise than second rate in quality, since the close double stars must often escape notice.

For the determination of the time, since we have as yet no conveniences for mounting the portable transit to be hereafter mentioned, I have made use of the instrument belonging to Mr. Davis. The north shutter of the transit-room being out of repair, I contented myself for the first two days with observations of such stars as could be seen through the remaining openings, and only on the 25th instant first obtained an observation of the Pole Star. In these observations Mr. Davis has assisted, and it would greatly relieve me could he or some other competent person be regularly employed to make the necessary daily time determinations.

The daily comparisons of the clock with the chronometers to be hereafter mentioned, and the regular meteorological observations are systematically made and recorded, as constituting a necessary part of the work of an Observatory.

FUTURE ACTIVITY.

With this summary of what has been done within the past three weeks, as preparatory to the future, I wish to explain, as

fully as may be advisable, the course that recommends itself as the wisest that we can adopt.

Since its foundation the Observatory has been considered as partly a means of gratifying the general curiosity of its friends in matters pertaining to the heavenly bodies, and partly as a means of advancing the science of Astronomy. The former at first naturally claimed a great share of the Director's attention: but as the general expectation of results useful to the community can not be satisfied so long as the Observatory work is liable to continual interruptions from privileged visitors, I recommend to substitute for the former department of usefulness another which will be much more satisfactory to the community, more honorable to the Society, and more profitable to the Observatory; one which, if well occupied, will indeed entitle us to that rank among the Observatories of the world to which we have been aspiring for twenty-five years.

If the Director be sustained in the general endeavor to make the Observatory useful, he would propose to extend the field of activity of the Observatory so as to embrace, on the one hand, scientific astronomy, meteorology, and magnetism, and, on the other, the application of these sciences to geography and geodesy, to storm predictions and to the wants of the citizen and the land surveyor.

In elaborating the details of this extension, we would remark:

I. The possession of our large equatorial indicates to us the field in which we can best further astronomical science. The usefulness of this instrument is, however, enhanced many fold if it be supplemented by two others, which are also of great importance to the proper execution of the work to be hereafter mentioned. I refer to the Meridian Transit Instrument and to the Vertical Circle. With or without these important auxiliaries, as the case may be, however, the following are such works

as the equatorial is eminently fitted to be employed upon, some of them being already in progress :

- (a) The revision of the heavens for new double stars.
- (b) The revision of the heavens for new nebulæ.
- (c) The revision of the heavens for new asteroids.
- (d) The observations of relative positions of multiple stars.
- (e) The observations of relative positions of nebulæ and adjacent stars.

(f) The observations of relative positions of asteroids and adjacent stars.

(g) The observations of relative positions of planets and their satellites.

(h) The observations of relative positions of solar spots.

(i) The observations of relative positions of comets.

(k) The observations of relative positions of special clusters of stars.

(l) The observations of relative positions for differential parallaxes.

(m) Zone observations of stars fainter than the ninth and tenth magnitudes.

(n) Physical appearances of the sun, moon, and planets.

(o) Drawings and studies of the most interesting nebulæ and comets.

(p) Observations of occultations, eclipses, and occasional phenomena.

(q) The addition of a spectroscope as an auxiliary to the equatorial will enable us to engage in the investigations bearing upon the physical constitution of the heavenly bodies, but the use of this instrument demands so perfect a protection from the wind and so accurate a clock-work motion that it would be well nigh useless in the present condition of the equatorial room.

(*r*) The addition of a photographic apparatus would enable us to use the equatorial for the purpose of photographing not only the sun and moon, but especially the double stars and intricate clusters. Here again, however, the present construction of the observing room offers many disadvantages, and this class of observations must be reserved for a more favorable period.

(*s*) The Zöllner Photometer can be very easily applied as an auxiliary to the equatorial, and as its use does not imperatively demand so steady a clock-work motion as the previously mentioned auxiliaries, I would respectfully recommend the purchase of such an instrument, as it will enable us to engage in a very important class of observations which promise to add largely to our knowledge of the heavenly bodies.

II. In meteorology the Observatory ought to keep a record of regular hourly observations of all phenomena depending upon the atmosphere. The value of these records will be greatly enhanced by using self-recording instruments.

III. In magnetism a regular record should be kept of the variation of the compass needle, of its dip, and of the horizontal force. Here, again, self-recording instruments should be introduced. Every attempt should also be made to collect similar data from neighboring portions of the country, and especially from the records of the past fifty years, in order to discover the laws according to which these quantities change in value.

IV. The simplest application of astronomy consists in the determination of time. This is always a daily duty in a well-organized observatory. But the regular transmission of the correct time to the city, or to private corporations, may involve some outlay; especially will it necessitate an assistant who can supply the place of the Director in case of his absence.

V. It is well known that from most ancient times astronomy has been the guide and friend of the mariner. He is de-

pendent entirely upon astronomical observations in determining his latitude and longitude at sea; and, similarly, travelers exploring unknown lands determine their courses and their positions by astronomical means. Practical astronomy offers by far the most expeditious and convenient means of laying down the groundwork for a map of any large tract of country; the filling in of the details of the surface belongs to the topographical surveyor.

Our ignorance of the geography of our own land is so great, that the maps of even the Eastern States are continually found to be grossly in error, and we have here an almost unlimited field of labor open before us. Our own State, and the adjoining States of Indiana and Kentucky, offer most admirable facilities for the application of the methods so successfully introduced by Struve into the surveys of Russia. Every contribution of this kind will be welcomed most gladly by the thousands who are continually making or using maps.

VI. The astronomical method of determining the position of points on the earth's surface, however, requires that we know the exact size and shape of the earth, which, as is well-known, is by no means a sphere nor even a true spheroid. This knowledge we already possess for certain portions of the earth's surface, especially for Europe and India. In America, however, there is still needed the measurement of an arc of the meridian, and of one of longitude. These immense geodesic triangulations centre in our city, since the arc of the meridian, whose measurement is the most feasible, passes from the Straits of Mackinac to the Gulf of Mexico, and the most desirable arc of longitude passes from Washington to San Francisco.

The accomplishment of such works as are here indicated, demands a lifetime, but by making an earnest beginning we shall

insure final success, and make Cincinnati the centre of a most important national undertaking.

VII. In connection with the geodesic triangulation, the use of the Bessel-Repsold Reversion Pendulum is an important auxiliary; and independently of the triangulation, we shall make a most important contribution to our knowledge of the earth's internal constitution by conducting a Pendulum Survey of the country bordering on the meridian line above alluded to, running north and south from Cincinnati.

VIII. One of the most important geodesical problems is the determination of the difference in level of two distant points. The annual expenditure of large sums of money in railroad and canal surveys, show us the value of this knowledge. The accurate determination, however, of the difference in level of distant points, is a very difficult problem in geodesy. It would facilitate many branches of industry if in every county there should be established at least one point of reference, or "bench mark," whose altitude above the standard plane of reference should be determined with great care and accuracy, and to which other neighboring points could be referred.

IX. The science of meteorology is slowly advancing to that point at which it will begin to yield most valuable results to the general community. Although we can not yet predict the weather for a week in advance, yet we are safe in saying that, with a proper arrangement of outposts, we can generally predict three days in advance any extended storm, and six hours in advance any violent hurricane. This may be effected simply by constituting the observatory a central station, to which telegraphic reports of the weather are regularly daily transmitted. The careful study of these despatches enables the meteorologist safely to make the predictions mentioned, which can be at once disseminated through the public papers or otherwise. In France,

Italy and England, and on our own eastern coast, such storm-warnings are considered of very great importance.

X. Terrestrial magnetism finds its most important applications in the labors of the navigator, explorer and surveyor. All who use the compass needle need to know its variations from the true north. This variation, as is well known, is changing hourly and yearly. Surveys of lands based only on the compass must be rectified by allowing for the error of variation, and if this be not known often after the lapse of twenty-five years it becomes a matter of great difficulty to retrace the boundary lines as defined in the original deeds.

Only our own State, and a very few others, have wisely directed that every county shall have a fixed meridian line, and that every survey shall be regulated thereby.

It will be our duty to assist in making such meridian lines, and to collect such data as will enable us to determine, at least approximately, what the variation has been at any point within our State, and at any time since its settlement. Such knowledge as this is oftentimes of the greatest value in important lawsuits concerning lands.

As the whole of the land belonging to the Federal Government has been surveyed by the compass, and as the phenomena of the magnetic needle are connected together over the whole world, our results have more than a local—rather, indeed, a world-wide interest.

XI. The proper conduct of each or all of the preceding undertakings will necessitate a more or less complete scientific library, such as will, when once well indexed, constitute a centre of attraction for students and others engaged on similar works. It will be our object, by exchanges and purchases, to build up such a library as rapidly as possible.

XII. In proportion as our reputation has suffered in the

past, by failing to publish to the world the results stored up in the observation books of our archives, and in proportion as we desire to secure the attention and respect of the world, must we disseminate our results by publishing them in pamphlet form and sending them to our co-workers in these fields of usefulness. Systematic observations should be published at the close of each year; special observations at the close of the series.

XIII. It is not to be supposed that the growth of our Observatory can be aught else than slow, especially so from the need of well-trained assistants. Although in the beginning of such an enterprise the management is given quite completely into the hands of one director, yet eventually it must become an association of *savants*, and practical men, with an executive or responsible head. In order that we may insure the most effective co-operation it seems best to found here, at once, a school of practical astronomy and geodesy, in which the tuition and use of instruments shall be free to all young men who desire thoroughly to perfect themselves in these departments.

For the encouragement and sustenance of worthy young men, especially such as come from our own city high schools, it is to be hoped that scholarships, yielding a moderate income, may be established by our citizens—as is done in the universities of our Eastern States and of England.

If the preceding outline of what may be done here seem to demand such material resources as we can scarce ever hope to command, I beg to add that we ought at least to keep this wide-extended usefulness ever before us as our special and proper field of labor. In order to remove any misapprehension, I would add that the expenses of our Observatory will not arise from costly edifices, nor even from costly instruments, but from the salaries

of the many able men whom we should endeavor to attract to it, and who will form the nucleus of a scientific and literary circle such as is found in but few cities in the world.

THE INITIATIVE.

If the Board of Control agree with me in giving this direction to our labors, I may be allowed to say that, anticipating our entire harmony, I have been making certain inquiries which have led to the following information :

1. There is a demand by certain parties for a more accurate knowledge of the latitude and longitude of prominent points in Kentucky and Tennessee. Quite an honorable contract may be entered into by the Observatory to furnish this information.

2. I have received an invitation to lay out a meridian line in a certain county in this State, a work that can be executed only by astronomical observations, and which will afford me an opportunity simultaneously to determine the latitude, longitude and magnetic variation for the point visited.

3. Learning that much inconvenience is felt in the city from the want of standard mean time, I have prepared a memorial to the City Council, setting forth that as we have long furnished such time to certain clock makers in this city whenever they have desired it, we are able to furnish the city directly and regularly as often as may be required with the correct time.

4. Learning that a complete set of costly self-recording magnetic instruments is in the possession of the Coast Survey, I have received unofficial information that if we will furnish an observer, and the simple building required to shelter them, they shall be placed at our disposal.

5. A daily bulletin of telegraph dispatches from the meteorological observers of the country being necessary to the predic-

tion of storms, I have received the promise of the hearty co-operation of the Smithsonian observers, and also of those of the army, as well as of certain of the telegraph companies.

6. In connection with the proposed School of Geodesy and Practical Astronomy, it is proper to say that, to the best of my knowledge, this field is at present occupied alone by the Military Academy at West Point, excepting those schools in which either topography or the use of fixed instruments is taught. It will be pleasant to the Board to learn that I have lately been written to by a Professor of Mathematics and Astronomy in a distant university, inquiring upon what terms he can reside with me, and acquaint himself with the workings of our Observatory. I desire to open our doors widely and freely to all such, and I deeply regret that our present dwelling is so fully occupied that I can not offer the gentleman referred to entertainment as the guest of the Observatory.

7. Finally, and in connection with our geographical activity, I have to mention a most interesting incident that occurred just before my departure from Washington. It was found that in revising the "list of the positions of the principal astronomical observatories of the world," which has appeared annually in the national "Nautical Almanac and Astronomical Ephemeris," the name of Cincinnati was omitted. This omission was, no doubt, partly due to the fact that the position of this observatory with reference to the others of the world is only very roughly known. No accurate determination of its latitude is known to exist, and its longitude was determined in the infancy of the telegraphic method, by reference to the High School at Philadelphia, and by using a very inferior transit instrument mounted on a very improper base at this Observatory.

Upon a consideration of these facts, Professor J. C. Coffin, the Superintendent of the Nautical Almanac, addressed a

note to the Chief of the Bureau of Navigation, Rear Admiral Thornton A. Jenkins, recommending that the proper instruments be loaned to the Cincinnati Observatory for the purpose of accurately determining its position. With the approval of the Honorable Secretary of the Navy, Admiral Jenkins, who has long exhibited a warm interest in the resuscitation of our Observatory, secured for our use a fine portable transit and a portable zenith telescope, and, in addition to these, three superior chronometers. It is difficult to overestimate the importance to the Observatory of this even temporary addition to its instrumental facilities, allowing us, as it does, at once to begin our geographical labors in the, to us, most important locality.

OUR LOCATION.

I have been thus minute in explaining of what seems to be the direction to which we can most wisely turn our energies, that I may now with propriety present to you that plan of future action which recommends itself by every consideration to our adoption.

In 1858, Professor Mitchel, in his report to the Superintendent of the Coast Survey, found himself obliged to apologize for certain deficiencies in the observations, caused by the smoke and hot air from the city, which often hid all but the brightest stars, and much impaired the value of his results. The reason which then existed, causing him to desire the removal of the Observatory, is certainly become more cogent now.

In the selection of a site for an observatory, it has long been recognized as of paramount importance that we should seek to avoid the heated air, smoke, dust and noise of cities, as also the moisture and fog accompanying river valleys, and the abnormal refractions which are found in both these situations. For

the most successful use of the meridian transit, it is necessary to have not only a north and south line, but also an east and west line, each a thousand feet in length and nearly horizontal. If the east and west line be somewhat shorter, the north and south one may not be diminished without risk of impairing the accuracy of our results. A high station and commanding view may be sacrificed if we secure the former desiderata—indeed a high hill often becomes an exceedingly inappropriate position, because of the exposure to the winds.

The neglect of these important considerations in olden times has entailed excessive inconvenience upon many of the most famous observatories. We may safely affirm that only the prejudice in favor of “the old homestead,” and the difficulty of effecting a removal from a long-established position could ever have retained the Royal Observatory at Greenwich or the Naval Observatory at Washington in their time-honored locations. For twenty years it has been almost unanimously agreed that the Imperial Observatory at Paris (now just two hundred years old) must be removed—and, serious as it may be to undertake such a step, yet, during the past winter, a commission has been appointed to recommend the proper course to be pursued—for the atmosphere of the city is proving more and more prejudicial to the work of the astronomer. Similarly, for over seventy years, the Imperial Observatory in the city of St. Petersburg has been nearly useless, and the eminent astronomer, Struve, insisted that the new observatory, built in 1835-39, should be located at least ten miles from the city limits. It was accordingly established in the village of Poulkova, on a broad plateau above the surrounding country, and has ever since maintained its reputation as the finest observatory in the world.

Therefore, even if the board do not coincide with the director in his desire to see the Cincinnati Observatory enlarge

its field of usefulness, I am confident that, in view of the probable rapid extension of this city, its suburbs, and neighboring cities, you will agree that now is the proper time for us to remove to a situation which shall be secure from inconvenience for the next fifty years.

If, on the other hand, we consider the extension that it is possible to give to our observatory, then we must acknowledge that the time may soon come when the four acres that we now occupy on Mount Adams will have become too small for us.

I, therefore, do not hesitate to recommend that the Board resolve at once to seek a new location for the Observatory.

In conclusion, let us ever remember that astronomy deals with the whole earth as a unit, and that our contributions to knowledge are not for Cincinnati alone, but for all mankind, and for posterity as well as for ourselves.

Very respectfully, your obedient servant,

CLEVELAND ABBE.

ANNUAL

Report of the Director

OF THE

Cincinnati Observatory

TO THE

BOARD OF CONTROL

FOR THE

YEAR ENDING MAY 1, 1869.

My Inaugural Report, presented on the first of July, 1868, touched upon what had been done during the previous month of June, but was confined principally to the general condition of the Observatory and its proper future course and needs. In the present Report there will perhaps have to be repeated somewhat of what was stated a year ago, but I shall confine myself chiefly to a brief synopsis of that which has been done in the Observatory, or elsewhere in its interests.

PERSONAL.

I have to acknowledge the temporary assistance of several persons. During the months of July, August and September, my brother, Mr. Robert Abbe, spent his college vacation with me, and rendered much assistance in many ways, and especially in com-

piling a catalogue of the books and pamphlets in the observatory library. In November, Mr. W. M. Davis removed with his family to their residence in the city, and Mr. David Kinney was engaged with his family to reside in the observatory building. A tedious illness having fallen upon me, I subsequently engaged the services of Mr. W. P. Kinney, who, although not paid by the Observatory, has for several months been able to devote spare days or hours, to such repairs and alterations as were demanded during the winter. The need of an assistant in carrying on the astronomical observations and computations makes itself more and more apparent, and I have accordingly addressed a note on this subject to several of the best schools in the city, and am encouraged to think that at least one young man will enter upon the study of astronomy with me during the coming summer. Such students should be properly reimbursed for such work as may be of advantage to the Observatory. It is very desirable to have also one student who shall give the subjects of magnetism and meteorology his special attention.

BUILDINGS AND GROUNDS.

Besides minor repairs, in the way of glazing, cleaning the cistern, repairing fences and wall, and cutting down dead trees, etc., I have to notice the removal of the dilapidated stable, which for years had been an eyesore to the neighborhood, and the rental of the cottage on the south side of the grounds to Mr. Keatley. The room under the transit room has been set apart as a work-shop. A large stove erected in the central hall has served well to warm the house. The room occupied by myself is the only one that can be said to be furnished, and its furniture has received but slight addition since last June. One of the front portico columns demands immediate attention, if it would be saved from falling and destroying the whole portico.

INSTRUMENTS AND THEIR APPURTENANCES.

The Equatorial.—The rolling roof of the Equatorial room continues to give a great deal of trouble, as it has done for many years past. An entirely new set of ropes has been introduced, and the iron railway put in good order, but the irregularities of the gearing wheels still require to be overcome. Whether the roof be rolled to the South or the North, however, the smoke from the Observatory chimneys is very apt to be caught under it, and to settle in clouds about the observer.

The instrument itself has received two thorough cleanings and several oilings; fixed steps have been attached to all sides of the pier; a very efficient dew-cap has been provided, and the necessary corresponding counterpoises have been made; the declination clamp has been altered to obviate its slipping. The eyepieces have been properly arranged and labeled. One of them is missing, and it is supposed to be in the possession of an eastern optician. The micrometer has received new threads. A micrometer lamp is much needed. The pier is found to be extremely sensitive to the least blow struck upon the ground anywhere near the building.

The Transit.—The instrument belonging to Mr. Davis having been dismantled in August, the portable Würdemann transit was on the 1st of September mounted on a heavy wooden block, standing between the stone pillars built by Professor Mitchel. The Würdemann transit is so mounted upon a turntable as to be readily set at any azimuth. The shutter of the transit room, and still more the roof gutters, leak so as somewhat to endanger the instrument in heavy storms. They can not be repaired without considerable labor.

The Zenith Telescope.—This instrument was temporarily mounted on the transit pier; but the shutter openings proving too narrow, I have now in course of construction a roofless house, within which it can be used in pleasant weather. It is a matter of deep regret that the completion of the pier and house for the zenith telescope has been so unexpectedly delayed that it is not yet finished, though, perhaps, one day's work will now complete it.

The clocks and chronometers remain as they were last June, excepting that the clock (Molyneux 151) was cleaned and oiled in September last, by Mr. Keller, at the expense of Mr. W. W. McGrew. It has not been stopped, or its rate altered, since the adjustment immediately subsequent to that event. The three chronometers have continued their admirable performance, although two of them, as their makers (T. S. & J. D. Negus) inform me, ought now to be cleaned, having already run over three years. These have twice run down during my absence from the Observatory. The rates of two of these have been remarkably uniform when kept at the proper temperature. Cold below 32° , however, affects them very largely.

Barometer and Thermometers.—These remain without any change—the barometer hanging in the transit-room, and the thermometers attached to a frame within a space sheltered on all sides by wooden-frame lattice work.

A self-recording barometer and thermometer was received in December from New York, but having suffered much damage at the hands of the express companies, it was returned to the makers. Such an instrument is, however, very much needed, in order to keep up a regular series of hourly meteorological observations, and similar apparatus for the registry of the wind is equally desirable.

In October Mr. W. Alden deposited with the Observatory two specimens of Smith & Beck's anemometers, with which many observations were made, but both are now out of repair; they are mounted upon a pedestal on the centre of the movable equatorial roof—that being the highest and fittest point on the grounds.

During the coming year it will, by all means, be desirable to procure one of the Pistor & Martin's prismatic sextants, also a simple apparatus for measuring base lines, and one of Zöllner's photometers, to be attached to the equatorial.

ASTRONOMICAL OBSERVATIONS.

The past year's experience has certainly developed greater hindrances to exact and satisfactory observations than had been foreseen. Frequent absence from the city, as hereafter explained, and the tedious illness before alluded to, have conspired to diminish the time possible to be given to observations.

The general course has been as follows: On still, clear evenings the equatorial was used until the deposition of dew covered the object-glass, or a light wind arose sufficient to disturb the adjustments, or to turn the smoke from the Observatory chimneys into the eyes of the observer, thus clogging up and injuring the delicate micrometer with which the observations are made. When the wind has been strong enough to prevent the proper use of the equatorial, I have given my attention to the transit instrument and the zenith telescope.

The observations with the equatorial embrace the following:

1. Observations for determining the adjustment of the telescope have been made on twenty stars, on five nights.
2. Measurements of fifteen double stars with the micrometer.

3. Observations of Jupiter's belts, and eclipses and occultations of his satellites.
4. Observations of Saturn's rings.
5. Determination of relative position of Neptune with reference to its neighboring star, 80 Piscium.
6. Measurement of the objective focal length, and the determination of the value of one revolution of the micrometer screw, by linear measurement as well as by observations of Polaris.
7. Twelve drawings and measurements of spots on Mars during and subsequent to its opposition.
8. Observations during the lunar eclipse, January 27, 1869.
9. The principal work, however, has been the revision of the southern heavens for new double stars, which has been prosecuted whenever the atmosphere was sufficiently steady and the wind not too strong. About one-sixth of the southern heavens here visible has been examined in nineteen zones, and forty-six double stars are recorded; their relative positions have been estimated, and their right ascensions and declinations observed to the tenth of a minute of time and arc respectively.

Many of these stars are so-called coarse double—the atmosphere and telescope being very rarely in a condition to detect the close and difficult double stars.

We have no means proper for observing the sun with convenience.

The use of the equatorial is attended with very great exposure of the person, owing to the unchecked and rapid radiation from the observing room when the roof is rolled off.

The transit instrument has been used only for the determination of the clock correction. I have made almost exclusive use of the elegant method recently developed by Mr.

William Döllén, and it has proved itself admirably adapted to the needs of the Observatory, since the transit pier need not be depended upon as to its position for any long space of time. Two hundred observations have been made according to this method, giving fifty time determinations.

The clock and chronometers have been compared together daily, with but few omissions except since the 12th of November last. The clock rate has been very satisfactory, but would be evidently improved if the clock could be placed in a cave or cellar of uniform temperature, as is now the frequent custom.

The zenith telescope has not yet been brought into use, but will be so soon as the house intended for its reception can be finished.

SHOOTING STARS.

Arrangements were made with many persons for simultaneous observations of the meteoric shower of last November. My own illness quite frustrated the completion of the programme and the working up of the results kindly sent me by other observers. The observations were finally transferred to Prof. H. A. Newton, of Yale College, who is the acknowledged leader in this department, and have been used by him.

Observations and charts of the paths of the meteors were received from

D. E. Hunter, Peru, Indiana.

W. C. Taylor, Philadelphia, Penn.

C. G. Boerner, Vevay, Indiana.

S. P. Langley, Pittsburg, Penn.

G. S. B. Hempstead, Hanging Rock, Lawrence county, O.

F. K. Atkins, Northfield, Rice county, Minnesota.

R. B. Warder, North Bend, Hamilton county, Ohio.

EXPEDITIONS.

Under this head must be included :

1. Some thirty visits generally during cloudy weather to various points in the county, suggested as proper sites for building an observatory in case of its removal. Of these a special report has been made.

2. A trip to Chicago to attend the annual meeting of the American Association for the advancement of science. This was extended to a journey to the Western extremity of the Union Pacific Railroad. In this trip I was particularly requested by certain parties to consider the advantages offered by the Summit Station, "Sherman," for the establishment of an observatory, but many matters of special interest to this observatory were attended to, as will appear hereafter.

3. An expedition to Ironton, Lawrence county, for the purpose of determining the latitude and longitude of that point, and of establishing a standard meridian line.

4. Several trips to Columbus and elsewhere in the interests of a proposed topographical and magnetic survey of the State.

5. Two short trips with barometers for the purpose of making a direct comparison between the Observatory barometer and others in use in the neighborhood of the city.

During the present spring, the barometrical comparisons will be continued, and the geographical position of Columbus, Ohio; Lexington, Ky.; Ludlow's Station, and possibly of some points in Alabama, will be determined. An expedition to Dakota, for the observation of the total eclipse of next August, is also contemplated.

CITY TIME.

The time has been furnished gratuitously to those clock makers who chose to apply for it. Two of them have done so

regularly. An offer to furnish it to the city on the same terms was made to Mayor Wilstach, during the past winter; it has not yet been acted upon.

GEODESY.

The longitude of Willow Island Station, on the Union Pacific Railroad was determined during my journey, in August last.

The longitude of Ironton, and the position of its meridian line were determined in November.

Preparations have been made for obtaining the position of Columbus and the latitude of Cincinnati, and to join by a small triangulation the Observatory with Ludlow Station—the point occupied by Colonel Jared Mansfield as his observatory in 1806–16.

The elevation of the Observatory above low water mark has been kindly ascertained for me by the employees of the United States Engineer Corps. In concert with Prof. O. N. Stoddard, of Oxford, Colonel J. Ammen, of Lockland, and others, barometrical observations were made last July, by which the elevations of several points were approximately determined.

Considerable pains has been taken to collect the data furnished by surveys for railroads and canals, and to deduce the relative altitudes of points in their routes. About two hundred such determinations are now at hand, but there must be thousands of such in the possession of surveyors and railroad engineers.

METEOROLOGY.

Although my frequent absence from the Observatory has entirely prevented a continuous series of observations of the barometer, etc., such as would be of value to the science of meteorology, yet such observations as were possible were made up to the middle of November. I have not yet recommenced

this series, as it loses most of its value because of its fragmentary nature.

In accordance with my desire to organize a Meteorological Union for the Ohio Valley, I have solicited reports from various observers, and have received or am promised such from

J. G. Rice, Princeton, Mariposa county, California.

U. T. Curran, Glendale, Hamilton county, Ohio.

M. S. Turrill, Cumminsville, Hamilton county, Ohio.

R. B. Warder, North Bend, Hamilton county, Ohio.

G. W. Harper, Cincinnati, Hamilton county, Ohio.

T. W. Gordon, Georgetown, Brown county, Ohio.

J. W. Hammitt, College Hill, Hamilton county, Ohio.

G. W. Oyler, Storrs, Hamilton county, Ohio.

A. B. Johnston, Avondale, Hamilton county, Ohio.

O. M. Langdon, Longview Asylum, Hamilton county, O.

G. A. Carnahan, Cincinnati, Hamilton county, Ohio.

D. B. Gamble, Cincinnati, Hamilton county, Ohio.

Young Ladies Seminary, Mount Auburn, Hamilton county, Ohio.

John Davis, Groesbeck, Hamilton county, Ohio.

Th. Weilson, Sparta, Randolph county, Illinois.

C. G. Boerner, Vevay, Indiana.

Theo. F. French, Carthage, Hamilton county, Ohio.

G. B. S. Hempstead, Hanging Rock, Lawrence county, O.

W. Brickley, Delhi, Hamilton county, Ohio.

G. A. Clause, Cheviot, Hamilton county, Ohio.

Mrs. Sarah Bodley, Storrs township, Hamilton county, Ohio.

W. A. Smith, Tolletstown, Lewis county, Ky.

A system of storm predictions having proved itself in Europe and India of the very greatest usefulness and value, an attempt is now being made to bring about such a system here, which will be of peculiar value to the Atlantic States, as most

of our storms originate this side of the Rocky Mountains and move eastward. I have secured observers at Omaha, Cheyenne and Sherman and Salt Lake City, who will co-operate as soon as a plan is fully matured.

Every opportunity has been improved to collect the data bearing on the meteorology of Cincinnati and Ohio during the past century. Much scattered information is received, but some years must elapse before the collection will be complete enough to publish. The Observatory is particularly indebted to Mr. Robert Clarke for the kind transmission of manuscript observations made from 1824 to 1833, by Thos. McBride, at Hamilton.

For use at the Observatory self-recording instruments are very much to be desired.

MAGNETISM.

The Observatory has no instruments proper for the determination of the magnetic elements, although application is frequently made to us for this information. The variation of the needle was obtained by me last August from the local surveyors on the route of the Union Pacific Railroad, several of them making several determinations. Their results agree well with the Isogonic chart published by the Coast Survey. Cincinnati was rendered quite an important and interesting point as regards terrestrial magnetism, by the labors of Dr. Locke, and it will be highly creditable if the Observatory seek to continue the reputation.

COMPUTATIONS.

As the scientific world has long looked, with interest, for the publication of the observations made at this Observatory, I have desired to begin this important work as soon as possible. The publications will be appropriately arranged as follows: Catalogue of new double stars; micrometrical observations of

double stars ; observations of solar spots ; zone observations of faint stars.

After spending about twenty days arranging and reducing the observations of the first class, I have reluctantly concluded that it is not advisable to proceed with their publication until some of the stars have been identified by me with the Equatorial, or have been found in some standard catalogue. This is necessary in order that the positions of the stars may be given with approximate accuracy.

The observations of the second and third classes have been taken in hand, and will be published during the present year.

A series of observations made with the Prime-Vertical Transit, at Washington, is also in my hands undergoing discussion ; as also a series made at the observatory at Poulkova, in 1865 and 1866.

A slight discussion of the connection between certain meteorological phenomena and the sun's spots is now nearly completed.

Besides the daily computation of time, etc., the other computations and studies are properly noticed under the following head.

PUBLICATIONS.

I have carefully collected the titles of the works published by Professor Mitchel and others, during their connection with the Observatory, and insert this list in the hope that it may receive further corrections and additions.

- I. Constitution of the Cincinnati Astronomical Society, together with the Officers and the names of the Stockholders. 8vo. Cincinnati, 1842.
- II. An Oration delivered before the C. A. S. on the occasion of Laying the Corner Stone, Nov. 10, 1843,

by John Quincy Adams, together with the Constitution of May, 1842. 8vo. *Cincinnati*, 1843.

- III. The Annual Address delivered before the C. A. S., June 3, 1844, by the Hon. J. Burnet. 8vo. *Cincinnati*, 1844.

(This includes the Constitution of 1844; the Act of Incorporation; the First Annual Report of the Board of Control and of the Director, and a Catalogue of the Stockholders.)

- IV. The Annual Address delivered before the C. A. S., June, 1845, by E. D. Mansfield, together with the Second Annual Report of the Board of Control, and of the Director of the Observatory. 8vo. *Cincinnati*, 1845.

- V. Account of the Foundation of the Cincinnati Observatory. Letter of O. M. Mitchel, April 7, 1845. *Astronomische Nachrichten*, XXIII, p. 99.

- VI. Observation of the Transit of Mercury, May 8, 1845. *Astronomische Nachrichten*, XXIII, p. 313.

- VII. The Third Annual Report of the Director of the Observatory. *Sid. Mess. Vol. I*, *Cincinnati*, 1846.

- VIII. The Sidereal Messenger—a Monthly Journal devoted to Astronomical Science, edited by O. M. Mitchel. Vol. I, 1846–1847. Vol. II, 1847–1848. Vol. III, No. 1, 1848.

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- IX. The Planetary and Stellar Worlds. 12mo. *New York*, 1848.
- X. The Geography of the Heavens, by E. Burritt, edited by O. M. Mitchel, with an Atlas. 12mo. *New York*, 1849.
- XI. Report of Professor O. M. Mitchel, of Cincinnati, on the Mechanical Record of Astronomical Observations. *U. S. Coast Survey Report for 1849*.
- XII. On a New Method of Observing and Recording Astronomical Right Ascensions and North Polar Distances, by O. M. Mitchel. *Proceedings Am. Assoc. Adv. Sci. at New Haven in 1850*.
- XIII. On the Longitude of the Cincinnati Observatory by Telegraphic Operations in connection with the U. S. Coast Survey, in 1848, by O. M. Mitchel and S. C. Walker. *Proceedings Am. Assoc. Adv. Sci. at Cincinnati in 1851*.
- XIV. Report of O. M. Mitchel to the Superintendent of the Coast Survey, on a New Method of Recording Differences of Declination by Electro-Magnetism. *U. S. Coast Survey Report for 1851*.
- XV. An Address delivered at the Dedication of the Astronomical Observatory of Hamilton College, June 16, 1856, by O. M. Mitchel. 8vo. *Utica*, 1856.
- XVI. Reports of O. M. Mitchel and H. Twitchell on the Moon Culminations observed at Cincinnati in 1856-1858. *U. S. Coast Survey Report for 1858*.

- XVII. On Personal Equation—a Letter to the Astronomer Royal. *R. A. S. Monthly Notices. Vol. XVIII, p. 261, 1858.*
- XVIII. The Great Unfinished Problems of the Universe—a Lecture delivered at the New York Academy of Music. 8vo. *New York, 1859.*
- XIX. Occultation of a ninth magnitude Star by Jupiter and by his First Satellite, by G. W. Hough. *Brünnow's Astron. Notices, No. 17, 1860.*
- XX. Popular Astronomy—a Concise Elementary Treatise, by O. M. Mitchel. 12mo. *New York, 1860.*
- XXI. The Astronomy of the Bible, by O. M. Mitchel. 12mo. *New York, 1863.*

There have been published during the past year the following :

- XXII. Inaugural Report to the Board of Control. July 2, 1868.
- XXIII. The Resuscitation of the Cincinnati Observatory. *Proc. Am. Assoc. Adv. Science, Chicago Meeting.*
- XXIV. A Letter to the Astronomische Nachrichten, July, 1868.
- XXV. Circular inviting Meteorological Observations for Hypsometrical Purposes. July, 1868.
- XXVI. Circular inviting Observations of the November Meteors. October, 1868.

- XXVII. The Meridian Line of Lawrence County. December, 1868.
- XXVIII. The Longitude of Ironton. December, 1868.
- XXIX. The Solar Eclipses of August, 1868 and August, 1869. January 7, 1869.
- XXX. Memorial to the General Assembly of the State of Ohio. March, 1869.
- XXXI. Dorpat and Poulkova.
An. Report Sec'y Smithsonian Inst. for 1867.
- XXXII. On the Altitudes of Eight Points in the neighborhood of Cincinnati. March, 1867.
- XXXIII. The Aurora of April 17, 1860. April, 1869.
- XXXIV. The Solar Eclipse of next August. April, 1869.

Of these works the stock now on hand is as follows:

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| No. | I. The Constitution and Stockholders, 77 copies. |
| | II. Adams' Oration, 1,343 copies. |
| | III. Burnet's Address, none. |
| | IV. Mansfield's Address, 408. |
| | XXIII. Resuscitation of the Cincinnati Observatory, 260. |
| | XXXI. Dorpat and Poulkova, 100. |

A translation of Döllén's "Zeitbestimmung" has been requested by the Navy Department, and would have been published during the past year had I not withdrawn it temporarily in order to add thereto certain improvements lately made by the author.

It is very desirable that the Observatory should itself assume the publication of such of its proceedings, or annual reports, as

may be of general interest, or at least secure a sufficient number of copies, in pamphlet form, to enable it to make to other observatories and astronomers some suitable return for the kindness shown by them in presenting their own publications to us.

ARCHIVES.

The records of the observations made at the Observatory have been arranged, labeled and indexed, and are now easily accessible. A number of original records are lost, but their place is supplied by what appear to be careful copies or summaries. The observations of the past year are contained in ten volumes of convenient size and uniform appearance.

EXCHANGES.

In pursuance of the time-honored custom established among scientific institutions, I have sent one hundred and twenty-six copies of publications, Nos. II and IV respectively, to as many European observatories, they having honored us by the presentation of their own publications at one time or another. One hundred and eight copies of the inaugural report of last July have been presented at my own expense, and fifty copies of No. XXXI as well as ninety-eight copies of No. XXVIII. Fifty copies of Nos. II and IV have also been placed in the hands of Robert Clarke & Co. for distribution among those interested in the Observatory in this city.

On the other hand the Observatory has received since the first day of May last donations from :

Dr. A. von Oettingen, Dorpat, Russia. 1 volume.

Prof. Carl von Littrow, Vienna, Austria. 4 volumes.

The Nautical Almanac Office, London, England. 1 vol.

The Radcliffe Observatory, Oxford, England. 2 volumes.

The Connecticut Acad. of Arts and Sciences, New Haven, Conn. 1 volume.

The Royal University of Norway, Christiania, Norway. 8 volumes.

Prof. E. Plantamour, Genève, Switzerland. 4 volumes.

The U. S. Army Engineers, Washington, D. C. 2 volumes.

The U. S. Naval Observatory, Washington, D. C. 2 volumes.

The National School of Medicine, Bucharest, Roumania. 4 volumes.

Prof. H. A. Newton, New Haven, Conn. 5 pamphlets.

The Department of Agriculture, Washington, D. C. 6 volumes.

The American Nautical Almanac Office. 6 volumes.

The Dudley Observatory, Albany, N. Y. 1 volume.

The U. S. Army Surgeon General, Washington, D. C. 2 volumes.

The Smithsonian Institution, Washington, D. C. 54 volumes.

Mr. Henry Twitchell, Cincinnati. 2 volumes.

The U. S. Coast Survey, Washington, D. C. 5 volumes.

Mr. Julius Dexter, Cincinnati. 3 volumes.

Mr. Robert Clarke, Cincinnati. 2 volumes.

Mr. Wm. Goodman, Cincinnati. 2 volumes.

The Cincinnati Y. M. C. A. 1 pamphlet.

Prof. G. B. Airy, Greenwich, England. 1 volume.

Prof. A. Secchi, Rome, Italy. 1 volume.

The Royal Observatory, Madrid, Spain. 4 volumes.

Prof. F. Kaiser, Leiden, Holland. 3 volumes.

The Austrian Meteorological Association, Vienna, Austria. 2 volumes.

THE LIBRARY.

This important part of the material resources of the Observatory for study and research was, as mentioned in my Inaugural Report, more than doubled in its quantity and value by the kindness of the officers of the National Observatory. During the last year but one addition has been made by purchase. The receipt by way of exchange, of 135 volumes, has been already mentioned. It was expected that the private library of Professor Mitchel would have been received ere this, but in this I have been disappointed. There are still missing a number of volumes known to have been once presented to the Observatory by European astronomers. It seems that at the time when Mr. Twitchell gave up his connection with this Observatory he suggested to Professor Mitchel the propriety of sending the entire library to Albany, as it would, it was supposed, be far safer there than here. On Professor Mitchel's death orders were given by his executors to return all works properly belonging to the Observatory to this city. In these journeyings the library may have suffered somewhat; through the kindness of friends in Europe, however, these losses will be partly repaired during the coming year. In order not to encroach upon the funds of the society I have purchased at my own expense such works as were pressingly needed in the Observatory; during the future such a course will be hardly necessary. As with few exceptions all astronomical works are published unbound, it has been necessary to expend a small sum in binding such as were in need thereof.

The library is classified and arranged upon shelving which will probably give sufficient room for two years to come. The catalogue is, properly speaking, of the nature of an "Accession Catalogue." A systematic index will be provided at some future

time; at present its place is well supplied by the invaluable catalogue of the Library of the Imperial Central Observatory at Poulkova.

The current number of the Accession Catalogue is 1614, which represents about 1200 independent volumes and pamphlets.

My private library contains about 750 volumes and pamphlets.

Desiring to make this, which is a special astronomical student's library, of more general usefulness, I have proposed a simple arrangement to the Trustees of the Public Library, by which, if accepted, a mutual benefit will result.

The character of the Observatory library is so anomalous, containing so many imperfect sets of series and wanting in so many really desirable works that I with some confidence express the hope that its deficiencies may receive immediate attention in case the existence of the Observatory be placed upon a permanent foundation. One of the best selected libraries of Europe, containing 1900 larger volumes and over 1800 dissertations, the property of the director of a prominent observatory, has been offered to this observatory at the very moderate price of six thousand dollars.

VISITORS.

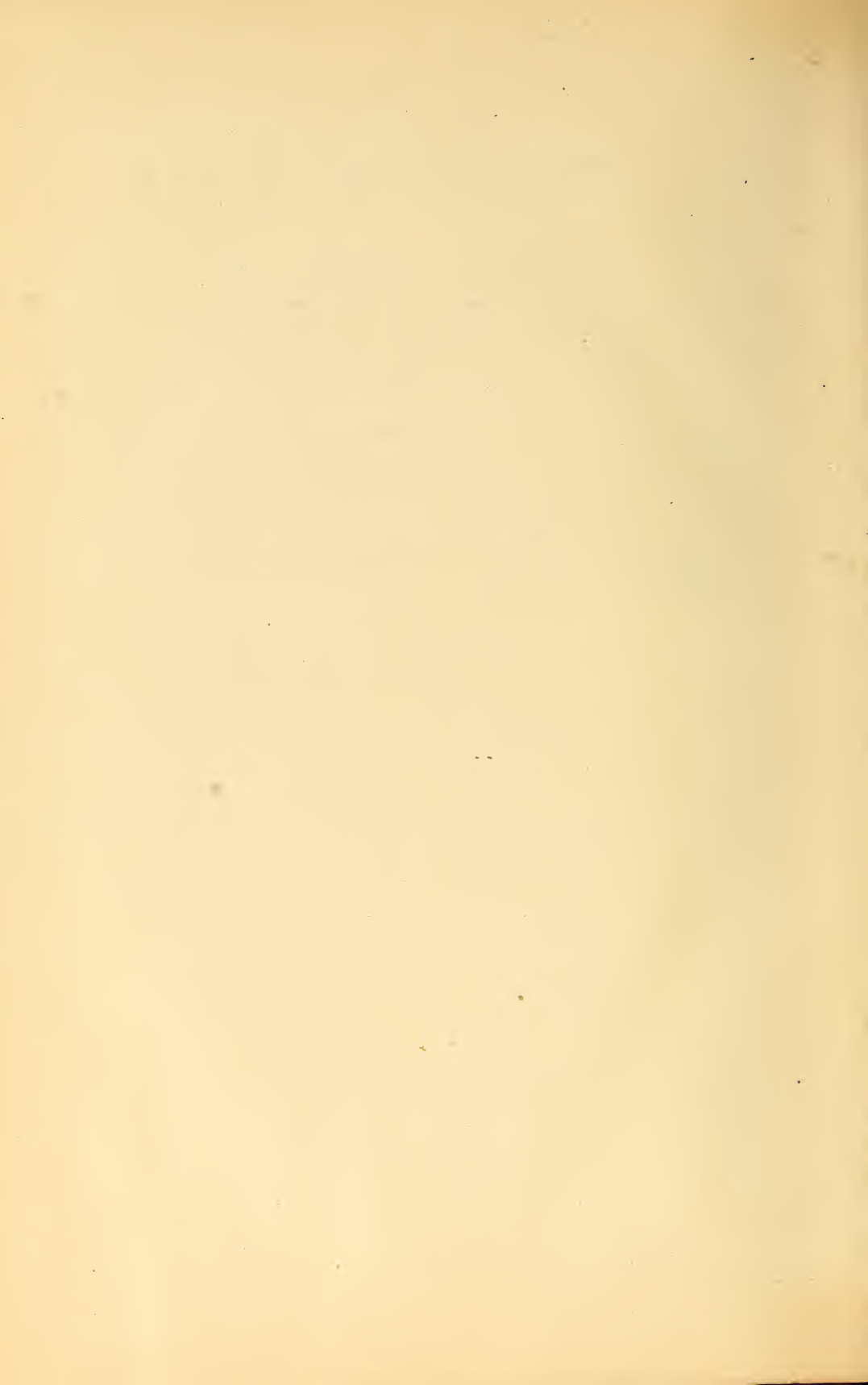
Whenever I have been present in the Observatory, visitors have been freely admitted; probably one hundred and fifty have visited the Observatory during the year. This course will be pursued in the future so far as it does not interfere with the observatory work. It would be highly advantageous if the Board of Control would inaugurate the custom of an annual official visit at the time of the rendering of the report of the Director.

CURRENT EXPENSES.

These have been largely increased by the necessity of providing stoves, etc., for winter use. Bills of sundries have been presented to the Treasurer of the Society at irregular intervals and promptly paid. The expenses of traveling, and of correspondence, and of needed books, have been borne by myself, though I shall hardly be able to do so during the future. Repairs have generally been made by myself or Mr. W. P. Kinney, with occasional outside assistance, the custom being established of purchasing tools and material and doing the work at spare hours.

CLEVELAND ABBE.









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